

60 per cent. It has maintained a most satisfactory state of aëration, since the air drawn from the bottom has contained, on an average, 17 per cent. of oxygen.

About 60 per cent. of the matter which settles from the sewage under ordinary conditions is combustible, and could, therefore, very well be dealt with by a destructor.

The tendency of the coke bacteria beds is undoubtedly to improve in their purifying power with age, provided they are not overworked. A bed which had given for some time a 50 per cent. purification, gradually increased in efficiency until its purifying effect reached nearly 70 per cent. The effluent from this bed underwent an additional purification of 20 per cent. by treatment in a second similar bed.

The effluent from a single coke-bed worked on the intermittent principle was clear and odourless, and remained in this condition when it was kept in open or closed bottles in a warm laboratory. It maintained the life of gold-fish, roach, dace and pike indefinitely: it was therefore not only well aërated, but was able to maintain its aërated condition. This proves that it was free from any rapidly oxidisable matter. It was undoubtedly, however, undergoing gradually further purification by the action of the bacteria which it contained, and with the assistance of dissolved oxygen. Such an effluent would be quite suitable for introduction into the tidal part of the river, where the water is too salt and muddy to be used for drinking purposes.

Bacteria are present in large numbers in the river-water itself, and undoubtedly exert a most useful purifying effect upon the water during its flow. The relation between the number present in the sewage and in the water of the River Thames, below and above locks, is shown by the following estimations made by Dr. Houston. The number of liquefying bacteria included in the total number of bacteria present in one cubic centimetre, and the number of spores of bacteria, are also stated:—

	Bacteria.	Liquefying bacteria.	Spores.
Raw sewage from North London, Feb. to April 1898	3,899,259	430,750	332
Raw sewage from South London, Feb. to April 1898	3,526,667	400,000	365
May to Aug. 1898	6,140,000	860,000	407
Effluent from coke-bed, South London, May to Aug. 1898 ...	4,437,500	762,500	252
[Percentage reduction by passing through coke-bed...]	[27·7]	[11·4]	[38]
Lower Thames water, Greenhithe, half ebb-tide, Oct. 1898...	10,000	—	63
Lower Thames water, Barking, low tide, Nov. 1898	34,400	—	89
Upper Thames water, between Sunbury and Hampton, Nov. 1898	5,100	—	56
Upper Thames water, Twickenham, Nov. 1898	3,000	—	18

The results obtained by the experimental bacterial treatment of sewage at Manchester during the last two or three years bears out generally those which have been obtained in London. The treatment has differed in some details from that adopted in London. The particles of coke constituting the coke-beds have been smaller. The coke-beds have been subjected to a larger number of intermittent fillings per day; and the preliminary treatment in an open anaërobic tank has been carried out with advantageous results. The scientific experts who have suggested and watched the experiments state their conviction that bacterial treatment is the treatment which is most suitable for Manchester sewage, but that in order to secure the most effective purification, the coke-beds

must have sufficiently frequent and prolonged periods of rest, and must be fed with sewage as free as possible from suspended matter, and as uniform in quality as may be. Preliminary anaërobic treatment is referred to as the best means of securing uniformity in quality of the sewage, and of adapting it to rapid subsequent aërobic purification. Four fillings in 24 hours have been found suitable, if one day's rest in seven is given to each coke-bed; the number of fillings, however, may exceed this without detriment to the bed or to the character of the effluent.

Town sewage is found to arrive at the outfalls at an almost constant temperature throughout the year. It rarely falls below 13° C. And this temperature not only prevents the possibility of the coke-beds being stopped by the freezing of the sewage, but also secures to the bacteria one condition favourable to their action. When a bed is too freely aërated by the passage of frosty air constantly through the interstices of the coke, this favourable condition is, however, seriously interfered with, and the bed may even become stopped by the freezing of the sewage.

In the more recent experiments carried out in America by the State Board of Health, Massachusetts, the tendency has been to use fine coke, and to allow the effluent from the coke to pass through sand. The passage of the liquid has either been allowed to take place with the outflow widely opened, so that the bed never fills; or the sewage has been allowed to fill the bed and to remain quiescent in contact with the coke for a time, as in the English experiments. The conclusions arrived at seem to be that the degree of purification obtained by the use of fine coke and sand is very satisfactory, but that the volume of sewage dealt with in a given time is smaller than when larger coke fragments are used, and the tendency seems to be to adopt the larger coke in order to expedite the more rapid drainage away of the effluent.

It will be seen from what has already been said that it is well not to speak of this system of treatment as one of filtration. Filtration ordinarily implies a process of mechanical separation of material suspended in a liquid. The fact that the coke-beds only commence their purifying action after they have been "primed" by repeated contact with sewage, and that this purifying action keeps increasing as the bed "matures," is sufficient to show that the action is by no means of a mechanical nature. It would be well, therefore, to speak of it as a process of bacterial treatment, and thus to indicate that the purifying agents are bacteria, which are acting under control, and are placed under conditions favourable to the development of their full activity.

It would be rash to say that the methods of bacterial treatment have as yet reached their most effective state; but it is significant that these methods have secured converts wherever they have received careful and air trial, and that those are their warmest advocates who have had the widest experience of their working. It is even probable that further improvements will be made in the means of treating sewage bacterially, but it is quite certain that the processes at present in use are able to secure the economical and satisfactory purification of ordinary town sewage.

FRANK CLOWES.

THE TOTAL ECLIPSE OF THE SUN.

SINCE the first series of telegrams was received announcing successful observations of the total eclipse of the sun on May 28, all the more detailed reports to hand confirm the universal satisfaction of the various parties at the results. As, however, most of the parties having a definite programme arranged to obtain photographic records, complete details cannot be known until the development of the whole of the plates, and in

some cases this will not be until the observers return home.

Rough prints from several of the negatives obtained with the prismatic cameras used by Sir Norman Lockyer's party show as great amount of detail as those taken in

The need for correction of the lunar tables is indicated by the universal experience that totality was some seconds *less* than that previously computed. The American observers estimate the difference as three seconds, while at Ovar, in Portugal, Mr. W. H. M. Christie, the Astronomer Royal, gives the time of totality as 85 seconds, whereas the calculated value was 93 seconds. Several observations indicate that the discrepancy is to be looked for in the moon's diameter being taken too large.

The most unfortunate victim of this error appears to have been Mr. Evershed, who journeyed to an outlying station, near Mazafran, so close to the limiting line of totality as was considered safe. He did this with the object of photographing the "flash" spectrum with as long duration as possible; this will be understood when it is considered that exactly on the central line the

duration of the flash will be merely momentary, but as the observer recedes from the central line the line of sight to the moon's limb becomes more oblique, until on the limiting line of totality the so-called "flash" is visible for the whole time of totality at that point. Owing to this ambiguity of the data, the station chosen was evidently somewhat further from the central line than was anticipated, and consequently Mr. Evershed had the unpleasant experience of less than one second totality. His preparations must have been exceedingly perfect, however, for he reports having obtained a good photograph at the proper instant, though it will fall short of expectation for the reason stated.

Prof. Howe, of Denver, has already determined the position of the planet Eros, which he was fortunate enough to discover on his photographic plates during the eclipse, and has circulated his result. The co-ordinates of the planet will be found in the "Astronomical Column."
C. P. B.

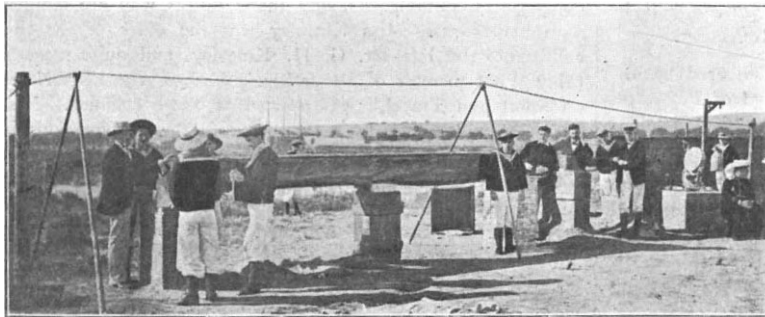


FIG. 1.—Two of the cameras fed by a coelostat.

1898. From a cursory examination of the negatives few differences appear in the chromospheric spectrum; the "1474" corona ring seems, however, slightly more feeble than before.



FIG. 2.—The 20-foot prismatic camera and siderostat.

In a letter received from Mr. Fowler he states that the negatives obtained by Mr. Payn with the 16-foot Cooke coronagraph are excellent, especially one showing the inner corona.

The accompanying illustrations, received too late for reproduction with Sir Norman Lockyer's letter last week, show some of the arrangements made for observing the eclipse at Santa Pola. Particulars concerning the various instruments will be found in NATURE of May 17.

Prof. H. H. Turner, at Bonsarea, near Algiers, successfully carried out his programme of photographing the corona, obtaining seven ordinary pictures and seven with interposed polarising apparatus. The polarisation indicated was decidedly radial.

Mr. H. F. Newall obtained the "first flash" and "corona" spectra with both slit spectroscope and objective grating, those taken with the latter, however, being weak. With Mrs. Newall he also made polariscopic observations.

Mr. W. H. Wesley made an excellent drawing from his observations with the eight-inch Coudé equatorial placed at his disposal by M. Trépied, director of the French observatory at Algiers. He reports that very little structural detail was discernible in the inner corona.

NOTES.

SIR ARCHIBALD GEIKIE, F.R.S., has been elected a Foreign Honorary Member of the American Academy of Arts and Sciences in the section of Geology, Mineralogy and Physics of the Globe, in succession to the late Carl Friedrich Rammelsberg.

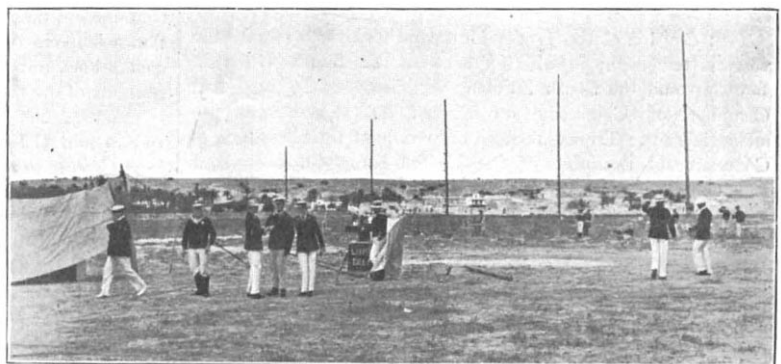


FIG. 3.—Discs on spars, for naked eye observations of the corona.

Prof. FOUQUE has been elected vice-president of the Paris Academy of Sciences for the year 1900, in succession to the late Prof. Milne-Edwards. Prof. Boltzmann has been elected to succeed the late Prof. Beltrami, in the mechanics section of the Academy.